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ABSTRACT

Did the emergence of social complexity in the Gulf of Georgia, Northwest Coast affect the social learning contexts of technologies? Barbed bone and antler technologies were examined from a Darwinian perspective using Boyd and Richerson's (1985) dual inheritance approach in order to further understand their social learning context. Barbed point attributes were examined for prestige-based indirect (context) bias (Henrich and Henrich 2007), the adoption of cultural traits due to unrelated traits, such as status. This form of transmission was expected to emerge with forms of hereditary social inequality evident by 2500 BP (Matson and Coupland 1995). Phylogenetic methods and cluster analyses were employed to examine spatial and temporal patterning in the stylistic and functional attributes of barbed bone and antler points. This study suggests the presence of individualized or affine-based learning in Northwest Coast barbed point technologies, and continuity in this mode of learning over the past 5,000 years.

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INTRODUCTION

Archaeologists working in the Northwest Coast culture area have documented the culture-historic trends and provided morphological classifications for many Coast Salish tool traditions (e.g. Burley 1980; Carlson and Magne 2008; Drucker 1943; Mitchell 1990). However, the ways in which tool stylistic variation has been influenced by shifting behavioral and social contexts has been less explored.

One key shift in such contexts is the development of social inequality in Coast Salish hunting-gathering-fishing communities. The intensification of a wide range of resources, including but not necessarily limited to large-scale salmon storage (Cannon and Yang 2011), beginning in the Locarno Beach phase (3200-2500 BP), and appearance of residential base camps is argued to indicate a transition from egalitarian lifeways towards a more hierarchical prestige system (e.g. Ames and Maschner 1999; Borden 1950; Matson and Coupland 1995; Matson 2008; Moss 2011).

By 2500 BP in the Gulf of Georgia, during the Marpole phase, a form social organization similar to that of the ethnographic period is suggested to have emerged as indicated by the shift towards large houses and households (Matson and Coupland 1995; Mitchell 1990). Status markers such as labret wear on anterior teeth, cranial deformation, and inherited prestige goods in child burials have also been used as supporting contextual evidence for increased social inequality over the past 3000 years (Ames 2001; Beattie 1981; Burley and Knusel 1989; Cybulksi 1991).

Cultural transmission studies can provide another means for exploring this significant social transition, by demonstrating that the learning of tool manufacturing traditions was influenced by the growing importance of prestige. An increased role for prestige in social learning is implied by the emergence of embedded craft specialists that were elites (Ames 1995: 158). Henrich and Henrich (2007) argue, based on models of gene-culture coevolution, that the presence of elites influences culture transmission in that lower status individuals are more likely to imitate the successful, higher status individuals (prestige bias). This study examines the role prestige bias may have played in the social learning of barbed bone and antler technologies in the Gulf of Georgia.

PREVIOUS COAST SALISH CULTURAL TRANSMISSION STUDIES

Studies examining cultural transmission among the Coast Salish (Croes et al. 2005; Jordan and Mace 2008) have relied upon phylogenetic methods to reconstruct culture-historic trends and detect whether the transmission had high or low fidelity through time. These studies have indicated that different forms of sociocultural transmission are present with different technological traditions, depending upon their specific contexts. For instance, Croes et al.'s (2005) study of wet site basketry revealed high fidelity cross-generational learning of highly guarded weaving styles through affinal kin.

Jordan and Mace (2008) performed a large-scale examination of the ethnographic literature to explore the relationships between language and gendered tool traditions. Jordan and Mace argue that the transmission of the manufacturing methods of Coast Salish textiles demonstrated a stochastic pattern with manufacturing methods being transmitted across linguistic barriers as a result of patrilocal movement. These studies reveal clear differences in the forms of transmission resulting from myriad factors, and emphasize the necessity of exploring multiple tool industries.

METHODS

Sample

Barbed bone and antler points from dated sites in the Gulf of Georgia and Puget Sound region were examined. In total 593 points were examined from 56 archaeological sites (Figure 1). Sites from the central coast were also included for use as an outgroup in the cladistics analyses (Figure 1 inset). Examined artifacts were from collections at Western Washington University, the Burke Museum, the Royal British Columbia Museum, and Simon Fraser University. Chronologically, the sample spans from 5500 BP to contact. Most examined points date to the Marpole and Gulf of Georgia phases (0-2500 BP). Provenience data, when available, was used to associate artifacts with site components.

Chronological Assignments

Site components were assigned 500 year BP time periods (Figure 2), based on mean conventional ^{14}C dates associated with each analytic unit. Sites lacking conventional radiocarbon dates were assigned to time periods based on mean age estimate. The majority of examine artifacts (N=513) had sufficient contextual information to be assigned a 500 year BP period. The majority of the sample dates from contact to 2000 BP, with 219 artifacts dated to the Gulf of Georgia phase (0- 1500 BP), and 251 to the Marpole phase (1500-2500 BP). Only 15 artifacts dated to the Locarno Beach phase (2500-3200 BP), while 28 artifacts dated from the St. Mungo phase or earlier (3200 BP+).

Procedures

An artifact was considered a barbed bone or antler point if a partial barb or a microbarb was present. Microbarbs are small ground grooves or notches on the harpoon shaft (Thompson 1978). Only finished artifacts were analyzed to ensure that all objects were from the same stage in the production sequence. David's (2003) *chaîne opératoire* analysis of Mesolithic barbed points was used as a basis for determining finished artifacts from blanks or preforms. Photographs of all complete artifacts are on file at Western Washington University. Raw photographs taken for this analysis are on file at the Burke Museum, Royal British Columbia Museum, and Simon Fraser University.

Cluster Analyses

Ward's method cluster analyses using squared euclidean distance were performed to explore the spatial distribution of point stylistic and functional attributes by 500 year BP period. Point attributes that were strongly patterned by ethnographically informed functional classes were treated as functional (Rorabaugh 2010), while residual attributes were considered stylistic. Jordan and Mace (2008) in their study of the cultural transmission of Coast Salish textile manufacturing methods suggest that in situations with a high degree of inter-group horizontal cultural transmission, cultural traditions would be transmitted around but not across the Gulf of Georgia. They suggest that the gulf would act as a barrier, and groups would tend for shorter range interactions. A direct comparison with Jordan and Mace's results was not possible as the sample of barbed points does not include materials from the regions of northeastern Vancouver Island they examined.

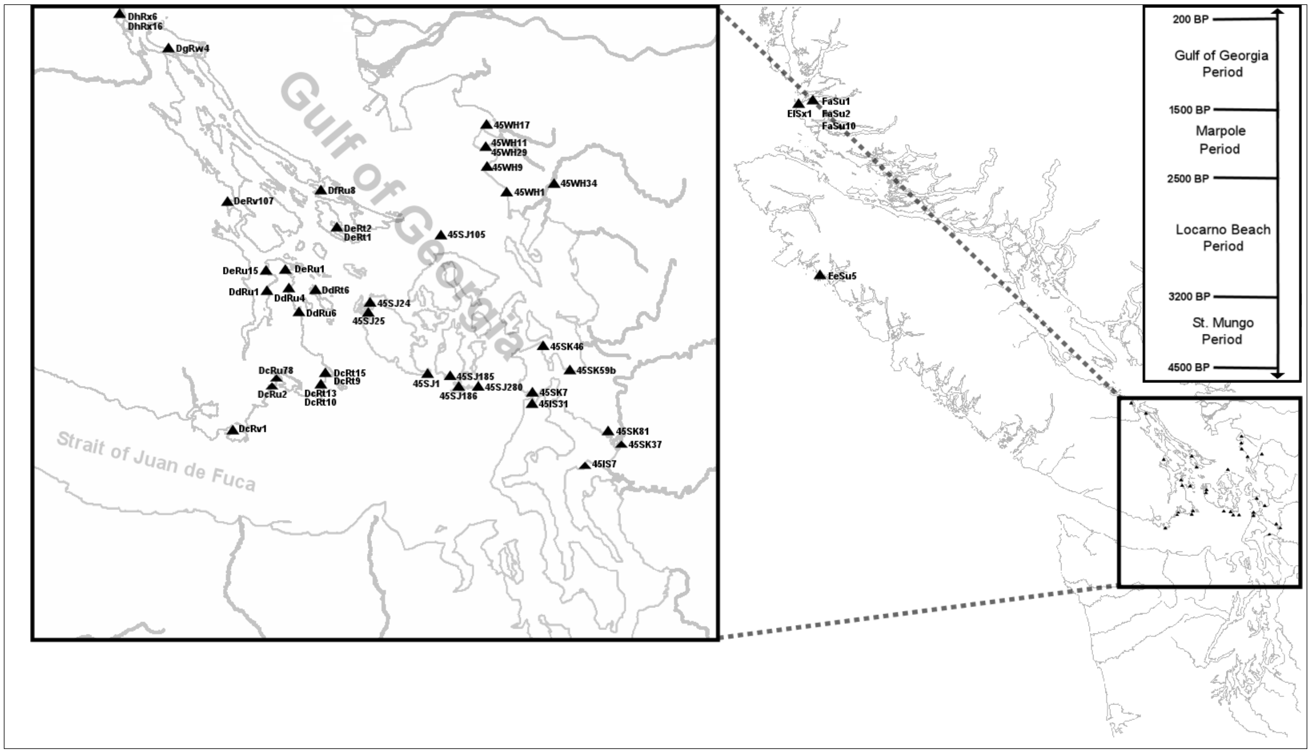

Figure 1: Sites with Barbed Points in Analysis and Gulf of Georgia Regional Chronology (Borden phases from Mitchell 1990:340).

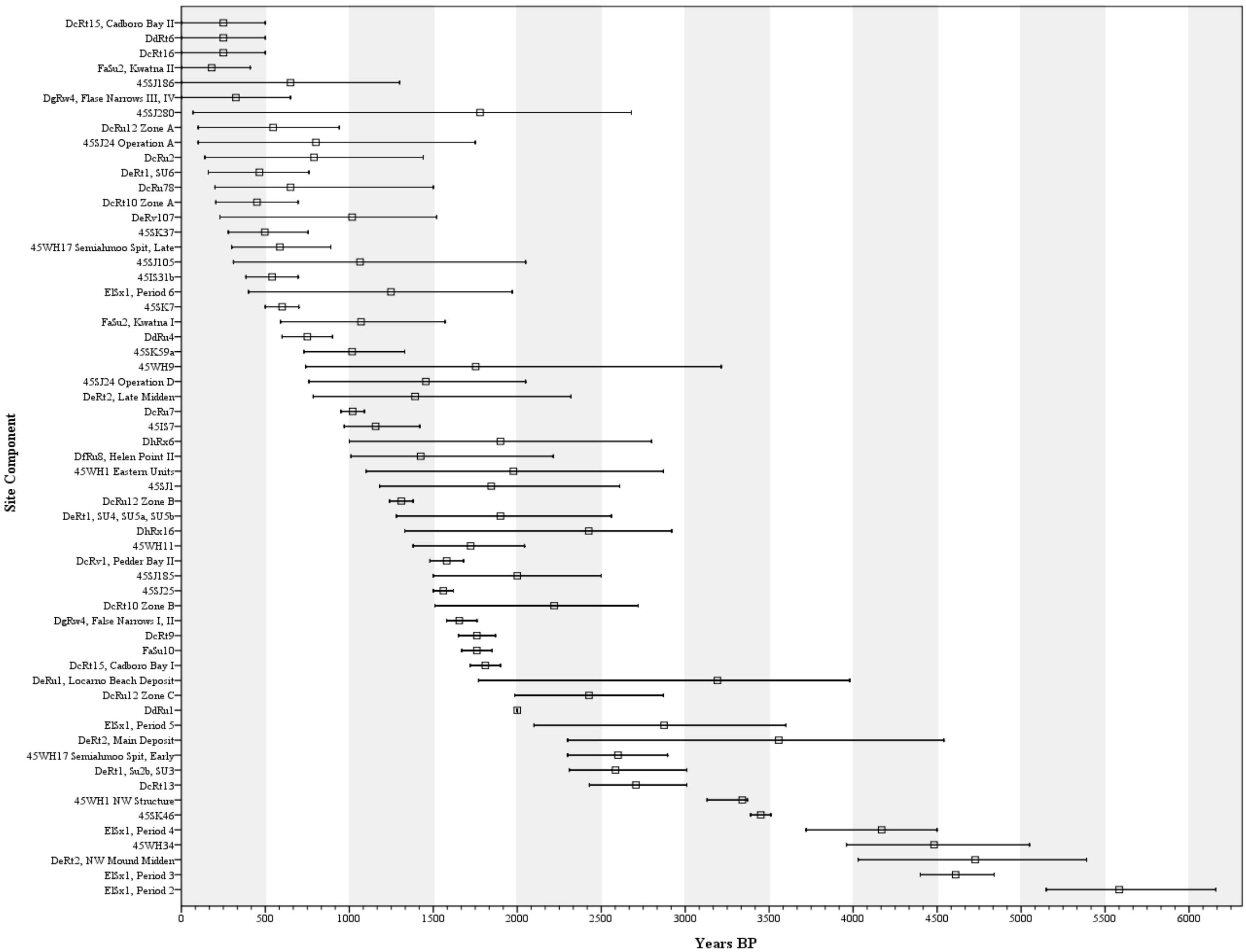

Figure 2: Radiocarbon Date and Age Estimate Ranges for Sites and Components (Arranged by Minimum Age, Mean Age Indicated by Box).

It was still possible, however, to generate expectations from their study. Due to strong convergent evolution caused by directed guided variation, the pattern of cultural transmission detected by Jordan and Mace (2008), where the Gulf acts as a barrier for transmission, was expected to appear in the cluster analysis of point functional characters. I predicted that functional characters would be similar throughout the Gulf of Georgia, resulting in clusters with members from a large geographic range. Stylistic attributes were expected to be more conservatively transmitted than textile manufacturing methods (detected as being horizontally transmitted in their study) due to prestige bias. This should result in a high degree of geographic localization in barbed point styles when prestige bias emerges as a social transmission factor around 2000 BP.

Attributes Examined

Functional attributes were chosen based on their variation by functional class, described in Rorabaugh (2010). Projectile length, projectile width, projectile thickness, the presence or absence of a curved profile, barb application, head barb metric characters (length, width, maximum barb width, barb angle), shaft barb frequency, presence or absence of a line attachment, and base attributes (width, length, shape, and asymmetry) were all selected as functional attributes. Stylistic attributes, defined as not varying by functional class, included microbarb type, shaft barb angle, shaft barb morphological attributes (shape, extension, silhouette) and line attachment type. McMurdo (1972:114) argued that various forms of line attachment were functionally equivalent. Thus, line attachment type has been included as a stylistic attribute, while the presence or absence of a line attachment was included as a functional attribute. Shaft barb frequency was not included as stylistic due to the results of previous analyses, which indicate that it may be an attribute influenced by point function (Rorabaugh 2010).

Phylogenetic Analyses

Cladistics analyses were performed using the consistency index (CI) as a proxy for the degree of phylogenesis or ethnogenesis among shaft barb styles. This involved examining these attributes using phylogenetic methods. PAUP*4.0: Phylogenetic Analysis Using Parsimony version 4.0 (Swofford 1998) was used for the cladistic analyses. All analyses were performed using paradigmatic classes constructed from morphological traits (Table 1). Paradigmatic classes have been utilized as one of the main means of constructing taxa in archaeological cladistics (e.g. Collard and Shennan 2000; O'Brien and Lyman 2000; Buchanan and Collard 2007; Riede 2008). Derived, shared, stylistic characters were used as a basis for paradigmatic classes based on barb attributes.

Character	States	Coding
Barb Shape	Straight or Convex, Squared	A, T
Barb Frequency	Dense, Isolated	G, C
Barb Ridges	Present, Absent	A, T
Barb Silhouette	Enclosed, Extended	G, C
Microbarbs	Present, Absent	A, T

Table 1: Shaft Barb Paradigmatic Classes. Coding based on restrictions of ML approaches. Example class: AGAGA- Straight or Convex, Dense, Present, Enclosed, Present

Barb styles were selected for analysis as functional constraints pose a considerable problem for the construction and interpretation of cladograms from an archaeological perspective. Such manufacturing constraints are behaviorally attributable to directed guided variation, which is when a cultural variant is more attractive than other variants in the course of individual learning due to its adaptiveness. These constraints may result in a strong phylogenetic signal when the cost of failure in a task is high and there are limited optimal designs (Eerkens et al. 2006). If constructing a leister is a task that has specific functional requirements and little room for error, directed guided variation would mean that individualized learning would have a pattern similar to highly conservative forms of group learning. If the functional constraints of an artifact type are strong, one may not be able to determine if the phylogenetic signal detected is due to individualized learning with consequences or is due to conservative forms of cultural transmission.

This issue can be circumvented through adopting Dunnell's (1978) dichotomy of stylistic and functional traits as a heuristic. Based on this dichotomy, only traits that are functional would be influenced by directed guided variation, although functional attributes could be influenced by other modes and mechanisms of cultural transmission as well. As strong directed guided variation and moderate to strong conformist and prestige biases are equifinal in a phylogenetic analysis, only characters determined to be stylistic (Rorabaugh 2010) were examined.

All characters were coded as presence-absence data for compatibility with a maximum likelihood approach, originally developed to deal with nucleotide sequences (Felsenstein 2004:248). Analyses were performed using three scales of operational taxonomic unit (OTUs), individual artifacts as taxa, paradigmatic classes as taxa, and archaeological assemblages as taxa. The presence and absence of paradigmatic classes per site was used for characters in the analysis using archaeological sites as an OTU. Sites were selected as the OTU, instead of dated assemblages, in order to utilize as much examined material as possible in the analysis.

For the production of rooted cladograms, outgroups were selected from geographically outlying archaeological sites, ElSx1 (Namu), FaSu2 (Nuditliquotlank), FaSu10 (Kwatna), and EeSu5 (O'Connor site) (Chisholm et al. 1983: 396-397; Golder Associates Ltd. 1999: 73, 82; Hobler 1970: 86). At the scale of artifacts as the OTU, all artifacts from these outlying sites were selected as the outgroup. For the analyses using paradigmatic classes as the OTU, the classes present in ElSx1, FaSu2, FaSu10, and EeSu5 were initially going to be selected as the outgroup. However, a significant number of classes present at these outlying sites were also present in other assemblages. Due to this issue, the classes present in the 3500+ BP time period, the oldest sites examined, were used as the outgroup instead. In the analysis using sites as the OTU, ElSx1, FaSu2, FaSu10, and EeSu5 were selected as the outgroup.

Cladistics Optimality Criteria

In addition to running analyses using three types of OTUs, two forms of optimality criterion were utilized. The first is simple parsimony, directly comparable to the model developed by Eerkens and coauthors (2006). Higher CI values were expected at higher levels of OTUs, as the increased abstraction of artifact traits is expected to generate what would appear to be a stronger phylogenetic signal. Maximum likelihood was used as the second optimality criterion. Due to the fact that the number of possible trees that must be evaluated increases exponentially with the number of taxa (Felsenstein 2004:28), heuristic searches were necessary. As several equally parsimonious trees may result from a cladistics analysis, bootstrap 50% majority-rule consensus trees were constructed (Felsenstein 2004:342, 534).

EXPECTATIONS

Cluster Analyses

The clusters for functional characters were predicted to include sites from throughout the entire region in all periods due to shared artifact uses and functional constraints throughout the Gulf of Georgia. Stylistic character clusters for the Gulf of Georgia period were expected to consist of more widely dispersed components due to an increased need for personal identity markers on barbed points as inter-group interactions intensified with the emergence of the

'Developed Northwest Coast Pattern.'

Phylogenetic Analyses

A high consistency index value (CI >0.7) was predicted to be detected through the cladistics analysis, indicating biased transmission from prestige. High CI values were predicted to be found in all cladograms regardless of the out used. Low CI values (<0.5) would indicate a stochastic pattern of cultural transmission, caused by inter-group horizontal transmission, intra-group horizontal transmission, or undirected guided variation. Although the results of the maximum likelihood analyses were not directly comparable, numerically higher likelihood scores (<-15) were interpreted as indicating prestige bias. Similar to the maximum parsimony cladograms, it was predicted that as the scale of OTU increases so would the likelihood score. Low likelihood scores (<-30) indicated the presence of undirected guided variation as the cultural evolutionary force acting on these characters.

RESULTS

Cluster Analyses

Attributes Determining Clusters

There was considerable continuity in the attributes, which determined clusters throughout all time periods in both the functional and stylistic analyses. For the functional analyses, maximum projectile width was the primary attribute, followed by the presence or absence of a curved profile, and finally base width. Both projectile width and base width strongly vary functional class, while curved profile is part of the definition for leister. These attributes divide retrievable points and leisters from fixed points and fish hooks, meaning that the clusters roughly correspond with functional classes. Primary determining attributes for the stylistic clusters included the presence or absence of ridged shaft barbs, microbarb type, shaft barb angle. The division in shaft barb angles roughly corresponds with the difference between squared and straight or convex barbs. Barb extension and silhouette did not play a major role in the formation of clusters.

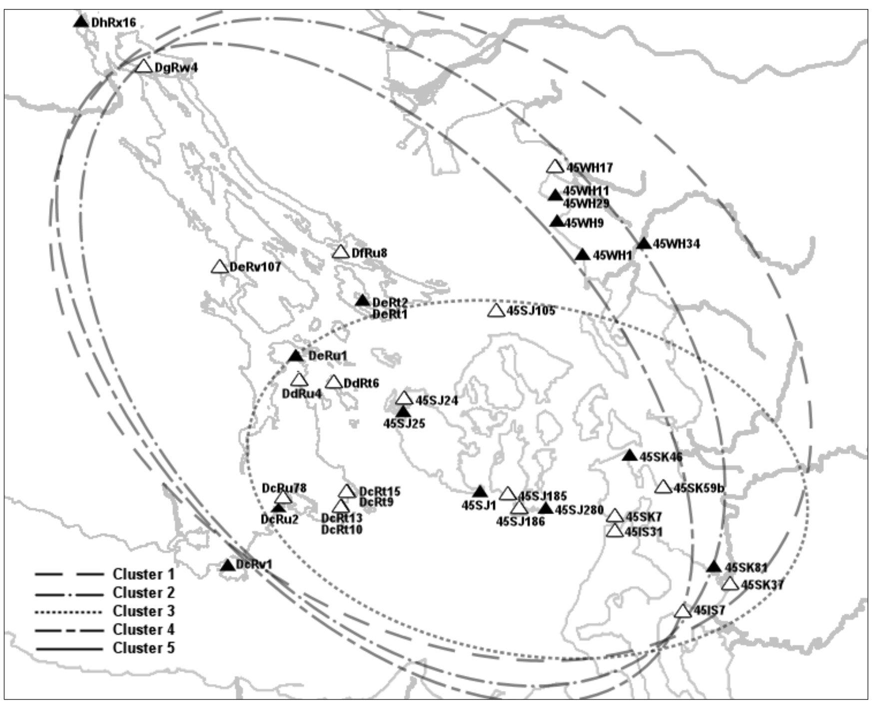

Figure 3: Geographic Boundaries of Gulf of Georgia Phase Stylistic Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

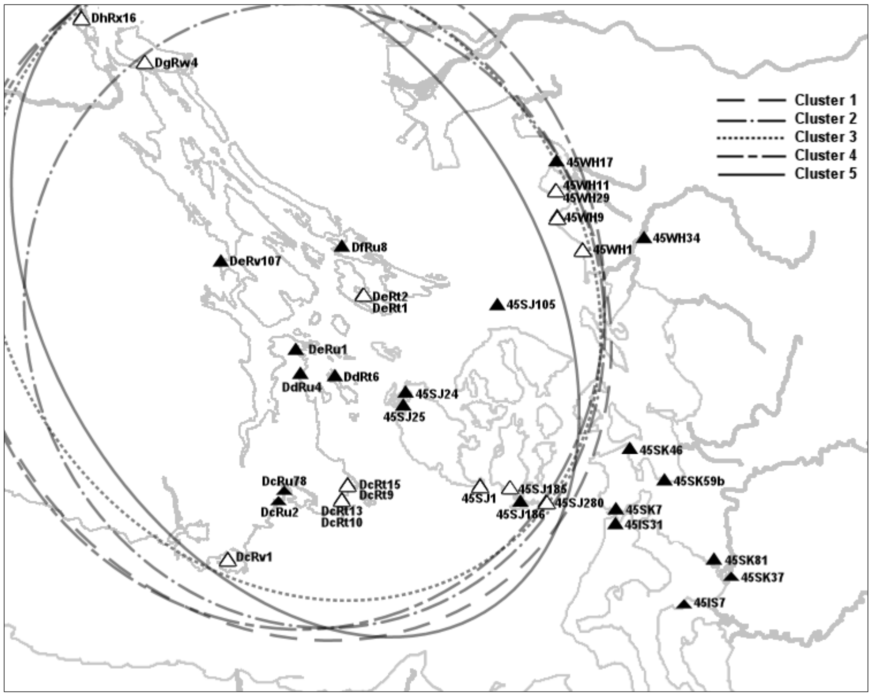

Figure 4: Geographic Boundaries of Marpole Phase Stylistic Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

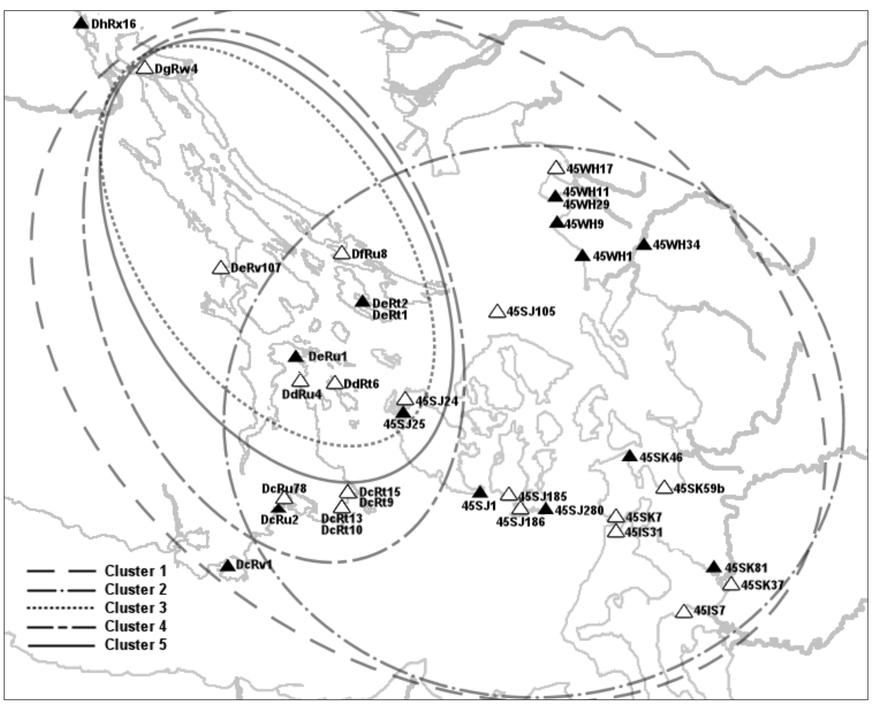

Figure 5: Geographic Boundaries of Locarno Beach Phase Stylistic Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

Geographic Distributions of Stylistic Attribute Clusters

Both the Gulf of Georgia (Figure 3) and Marpole (Figure 4) phase stylistic cluster analyses lacked clusters limited to specific geographic areas, with one notable exception. In the cluster analysis examining Gulf of Georgia period stylistic attributes (Figure 3), Cluster 3 is the most limited in geographic scope and consists of barbed points with both ridged barbs and microbarbs present. While ridged barbs or microbarbs are found throughout the region, areas where a combination of both attributes is present may be more limited in geographic scope during the Gulf of Georgia period.

Although the Locarno Beach (Figure 5) phase cluster analysis does appear to have distinct geographic clustering, this is likely due to small sample sizes. While the widespread geographic distribution of clusters was an expected result for the functional attributes, indicating similar functional types as present throughout the Gulf of Georgia, these results indicate that attributes such as ridged barbs, microbarbs, and barb angle were also present throughout the region in all time periods. Barb angle, I argue, serves as a proxy for barb shape and these results indicate that both squared and straight barbs are found throughout the Gulf of Georgia in all time periods.

Based on the results of this analysis, strong localized styles appear to be absent. Combined with the results of the previous analyses examining the frequencies of barb attributes through time it is apparent that different barb styles are found throughout the Gulf of Georgia in similar frequencies over the past 2500 years.

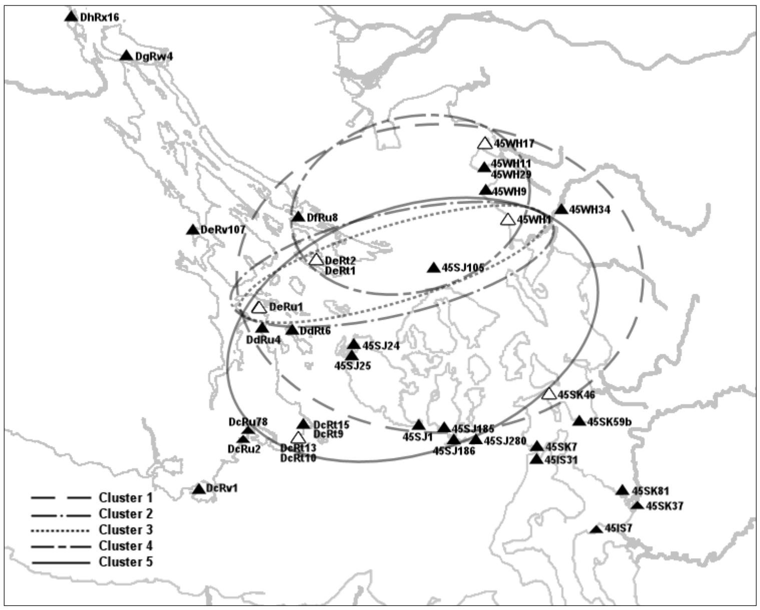

Figure 6: Geographic Boundaries of Gulf of Georgia Phase Functional Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

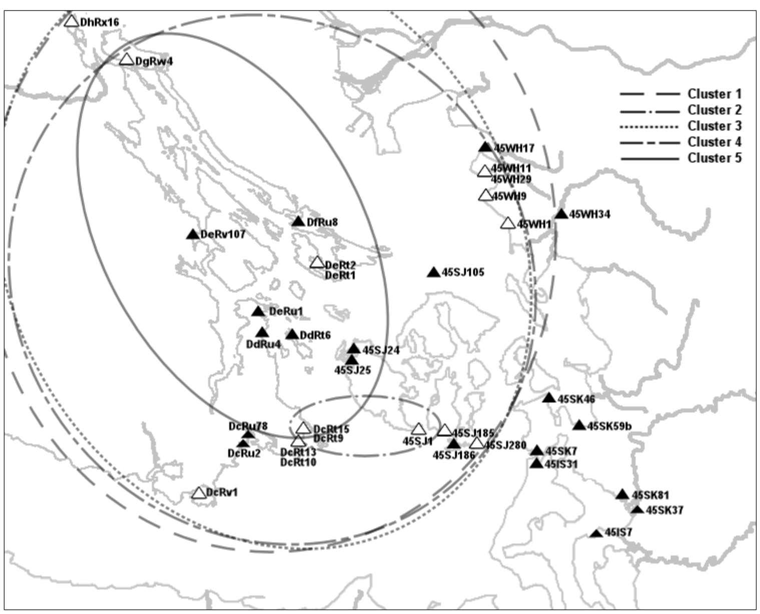

Figure 7: Geographic Boundaries of Marpole Phase Functional Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

Geographic Distributions of Functional Attribute Clusters

The cluster analyses of functional attributes resulted in some clusters that appear to be geographically distinct, such as Cluster 2 in the analysis of Gulf of Georgia phase functional attributes (Figure 6). This cluster consists of three robust retrievable points. Cluster 2 in the analysis of Marpole period functional attributes is similarly geographically bound, and consists of curved profile points with straight ridged barbs (Figure 7). These clusters are not believed to actually indicate localized forms, but instead likely reflect the overall rarity of robust barbed points in the Gulf of Georgia phase and the small sample size of leisters dating from the Marpole phase. The Locarno Beach phase cluster analysis (Figure 8) demonstrates what appear to be regional variants, Cluster 5 has a distinct geographic boundary as it is the only cluster containing DcRt13 (Bowker Creek) and 45SK46 (Deception Pass). (Carlson 1994: 328; Moss and Erlandson 2010: 3366) This is an effect of the small sample size from this period and not the result of more localized forms during the Locarno Beach phase.

Phylogenetic Analyses

Provided that shaft barbs are stylistic, high cladogram consistency index and likelihood scores should be indicative of phylogenesis resulting from biased transmission, as opposed to directed guided variation. Low consistency index and likelihood scores are attributable to inter-group horizontal transmission, intra- group horizontal transmission, or undirected guided variation reflecting ethnogenesis or individualized learning.

Contrary to expectations, the cladistics analyses of shaft barb morphology at all scales of OTU (cases as taxa, classes as taxa, and sites as taxa) did not indicate conservative modes of cultural transmission (Table 2). Although data matrix size may have an effect on CI values, there was considerable continuity in the CI values of all claodgrams regardless of OTU. When comparing the highest detected consistency index (classes as the OTU) to simulated CI values for undirected guided variation and conformist bias (Figure 9), the observed CI values fall closest to those for undirected guided variation. Modeled values of conformist bias from Eerekens et al. (2006) were chosen to represent indirectly biased transmission in general, as all forms of indirectly biased transmission are highly conservative in nature. The low CI values found in this analysis suggest that shaft barb shape is culturally transmitted through strong undirected guided variation, i.e. individualized experimentation without selective consequences.

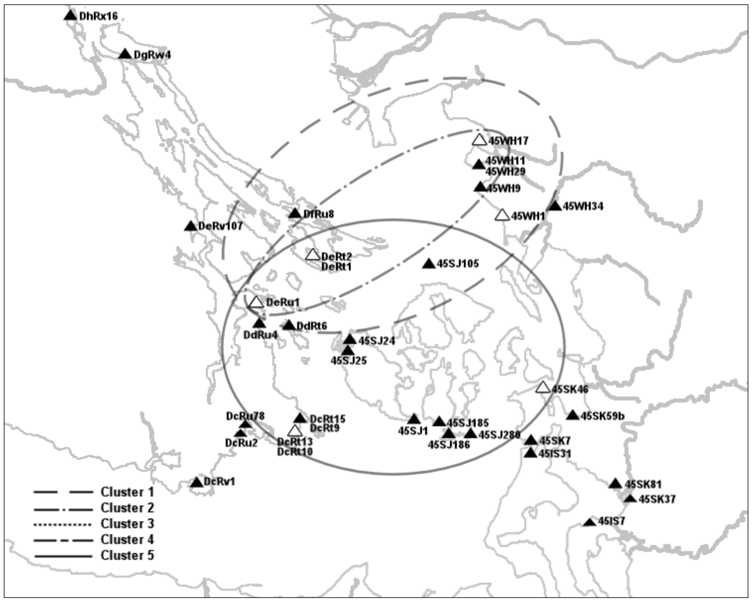

Figure 8: Geographic Boundaries of Locarno Beach Phase Functional Attribute Cluster Analysis (Sites with artifacts included in cluster analysis indicated by white triangles.)

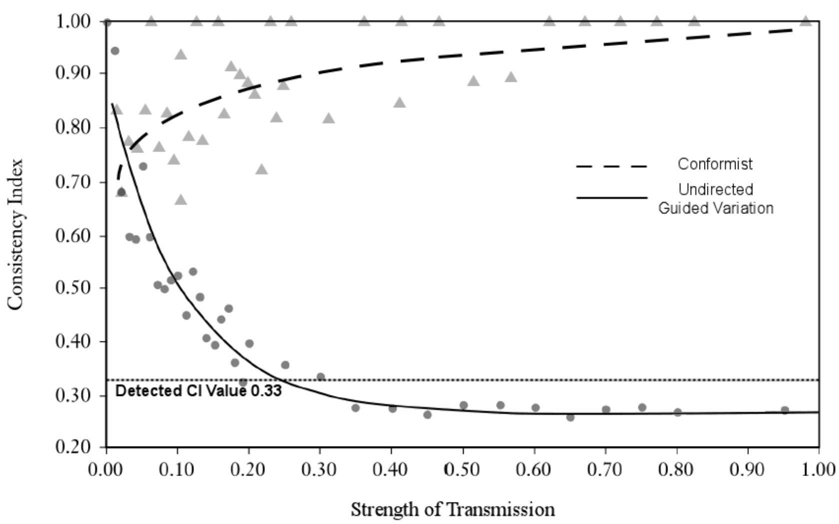

Figure 9: Comparison of Highest Detected CI Value to Simulated CI Values for Varying Strengths of Indirectly Biased Transmission and Undirected Guided Variation (Simulated Values from Eerkens et al. 2006: 176, 178)

Maximum Parsimony

Shaft Barb Shape Heuristic Search

Taxa	TL	CI	HI	RI
Cases	19	0.32	0.68	0.97
Classes	12	0.33	0.66	0.55
Site	60	0.22	0.78	0.68

Number of Replications=100
Distance Measure=Total Number of Pairwise Differences
Optimality Criterion=Parsimony

Shaft Barb Shape Bootstrap 50% Majority-rule Consensus Tree

Taxa	TL	CI	HI	RI
Cases	404	0.02	0.99	0.06
Classes	22	0.18	0.82	0
Site	162	0.08	0.92	0

Number of Replications=100
Distance Measure=Total Number of Pairwise Differences
Optimality Criterion=Parsimony

Maximum Likelihood

Shaft Barb Shape Heuristic Search

Taxa	Ln Likelihood
Cases	-26.91
Classes	-29.76
Site	-202.52

Number of Replications=10
Distance Measure=Total Number of Pairwise Differences
Optimality Criterion=Maximum Likelihood

Shaft Barb Shape Bootstrap 50% Majority-rule Consensus Tree

Taxa	Ln Likelihood
Cases	-19.22
Classes	-16.79
Site	-157.77

Number of Replications=10
Distance Measure=Total Number of Pairwise Differences
Optimality Criterion=Maximum Likelihood

Table 2: Cladogram Consistency Index Values.

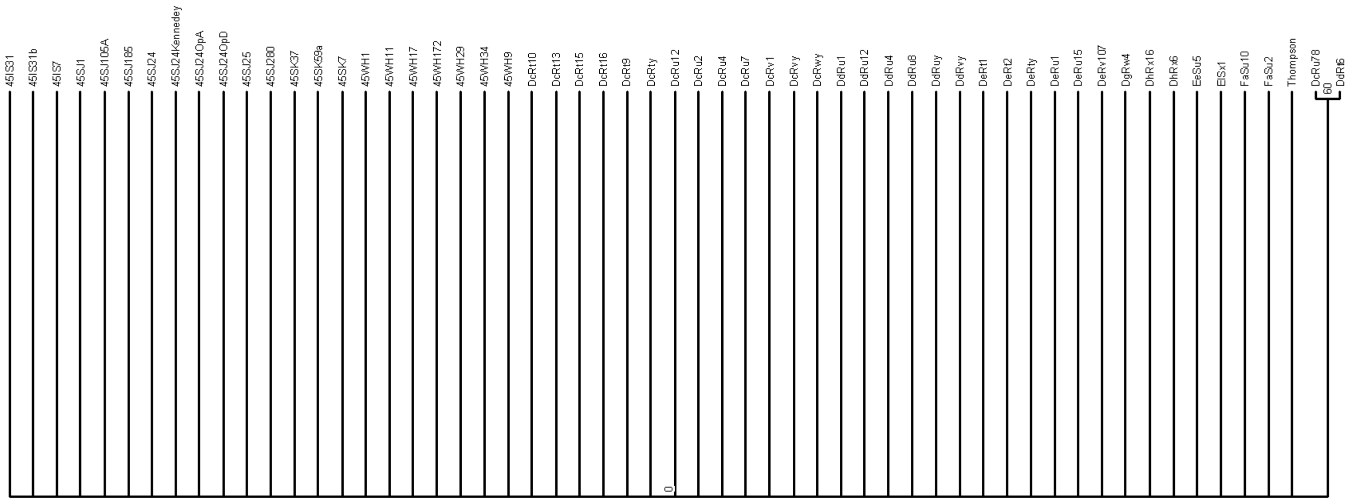

Figure 10*:* Bootstrap 50% Majority-Rule Consensus Tree, Sties as OUT. No clades were strongly supported, with the exception of DcRu78 and DdRt6 which form one moderately supported clade. Rooted using EESu5, E1Sx1, FaSu2, and FaSu10 as the outgroup.

The low CI values, also, mean that the maximum parsimony cladograms produced do not provide information on cultural lineages of shaft barb styles. The maximum likelihood approach, which is better suited for stochastic patterns, demonstrated considerable reticulation within each clade and so do not provide meaningful information on cultural lineages. Although the low observed CI values mean that the cladogram is weak from a technical point of view, from a manufacturing standpoint, the cladograms can be considered strong, as all traits were mutually exclusive, although the shared, derived nature of shaft barbs was an *ad hoc* hypothesis.

Individual artifacts appear to be the OTU most suited for maximum likelihood approaches as they resulted in numerically higher likelihood scores in the heuristic search (Table 2). Classes, however, worked well for the maximum parsimony heuristic search, yielding the shortest tree length and highest consistency index (Table 2). With the more conservative bootstrap approach, CI values, in general, increased with the scale of OTU as predicted, although artifact class was the OTU which yielded the highest CI value (Table 2). Due to the low detected CI values, the rooted cladograms were not informative of culture-historical relationships. Figure 10 has been provided as an example consensus tree, and demonstrates the stochastic pattern and weakly supported clades characteristic of all OTUs. Based on these results, I argue that shaft barb morphology, regardless of the intended function of the point, may be tied to highly individualized learning which pulls from a local cultural repertoire, or is connected to inter or intra-group peer learning.

DISCUSSION

Comparison With Previous Coast Salish Cultural Transmission Studies

Cultural transmission studies using material culture have primarily attempted to detect whether cultural transmission is conservative in nature (i.e. vertical or horizontal transmission) (e.g. Collard and Shennan 2000; O'Brien et al. 2001; Tehrani and Collard 2002; Jordan and Shennan 2003; O'Brien and Lyman 2003; Croes et al. 2005; Lipo et al. 2006; Buchanan and Collard 2007; Croes, et al. 2008). When conservative transmission is detected cultural cladistics analyses have generally assumed vertical cultural transmission (parent to offspring) in the interpretation of cultural lineages, an approach which has faced critique (Borgerhoff- Mulder et al. 2006; Shott 2008). This analysis has attempted to address these concerns by focusing upon the roles of specific mechanisms of social learning (e.g. Henrich and Gil-White 2001; Bettinger and Eerkens 1999; Eerkens et al. 2006; Henrich and Henrich 2007).

The results of this study correspond with the findings of Jordan and Mace (2008), in that the cultural transmission of Coast Salish technologies differ according to their specific contexts. A comparison of the work of Croes et al. (2005) with Jordan and Mace's (2008) study also has implications for future cultural transmission studies for the region. Croes et al. (2005) argued that the cultural transmission of Coast Salish textiles was conservative in nature, consisting of closely guarded family styles that were passed from mothers in-law to daughters in-law (oblique transmission).

Jordan and Mace's (2008) findings differed, and they argued that the transmission of the manufacturing methods of Coast Salish textiles demonstrated a stochastic pattern with manufacturing methods being transmitted across linguistic barriers as a result of patrilocal movement. Jordan and Mace (2008) examined differences in the technologies used for the production of textiles, which I argue could indicate differences in the early stages of the production sequence.

In contrast the attributes examined by Croes and coauthors (2005) were individual weave styles, which may be independent of the attributes examined by Jordan and Mace. It is plausible that differing stages of the production sequence of textiles may operate under differing modes and mechanisms of cultural transmission. I suggest that barbed points also exhibit the operation of differing transmission modes and mechanisms at different stages of production.

Assessing Cladistics as a Method of Determining Forms of Cultural Transmission

What has been glossed over in many cladistics analyses of material culture is the value of using cladistics as a method of exploring specific hypotheses regarding the modes and mechanisms of cultural transmission, as opposed to assuming 'vertical' transmission (see Bettinger and Eerkens 1999; Henrich and Boyd 1998; Eerkens et al. 2006 for examples where vertical transmission is not assumed). Even after a decade, cultural transmission studies are still preoccupied with the debate of phylogenesis versus ethnogenesis (e.g. Collard and Shennan 2000; Terrell 2001), attempting to justify the use of models from population genetics, to focus on the vagaries of specific modes and mechanisms of transmission, which reflect the more complex and nuanced nature of social learning.

This study attempted to answer a specific question regarding conservative cultural transmission, whether or not prestige bias was a factor in the social learning of barbed bone and antler point technologies. The methods employed here attempted to account for issues that resulted from strong artifact functional constraints, a factor not considered by many studies of the transmission of material culture. Strong functional constraints (directed guided variation) can result in a 'false' phylogenetic signal (due to homoplasy), which can be misinterpreted as conservative cultural transmission (homology). A second issue that should be addressed in future phylogenetic studies is ensuring that symplesiomorphic characters, ancestral characters shared by one or more taxa, are not selected. Selecting chronologically sensitive attributes present in a single functional type may be a method of avoiding symplesiomorphy. Choosing attributes unique to a functional class can be difficult even in artifacts with considerable morphological variation and may not be feasible for many analyses.

Although conservative cultural transmission was not detected in this study, while specific attributes may not yield a strong phylogenetic signal, they are not random 'noise,' i.e. that they are not meaningless in interpreting the cultural transmission involved in the creation of an artifact. While certain attributes and combinations of attributes may not yield a phylogenetic signal indicating conservative cultural transmission and thus be amenable to reconstructing a phylogeny, artifacts are the sum of socially transmitted behaviors. All aspects of a technology are subject to either factors of cultural transmission or individualized learning.

Ignoring certain artifact attributes because they do not yield strong phylogenetic signals, I argue, is akin to discarding lithic debitage because they are not finished artifacts. By ignoring these attributes, evolutionary archaeologists are potentially ignoring a wealth of information regarding the social learning contexts of technologies. For instance, this 'noise' may be valuable when attributes are examined in terms of production sequence. For a comprehensive analysis of the transmission of an artifact type, attributes from multiple stages of the production sequence should be separately examined, each stage of a production sequence being akin to Hennig's (1966:65-66) concept of the semaphoront. I suggest that bearing production sequences and artifact life history transformations in mind, in addition to the communicative potential and functional importance of attributes, can result in insights for reconstructing technological phylogenies.

CONCLUSIONS

Conservative forms of cultural transmission may play a role in the early stages of production of these technologies such as the selection of blanks, while final stylistic touches such as barb morphology are highly individualized. Functionally equivalent attributes with high morphological variation (barb shape, extension, and the presence or absence of barb ridges and microbarbs) may serve as identity markers. Barb morphology may have consciously or unconsciously served a purpose as identifiers for both groups and individuals.

Although a tendency to adopt cultural traits from the same ethnic group is often described in the cultural transmission literature (e.g. Collard et al. 2006, Henrich and Henrich 2007), this would result in distinct styles in each geographic region. However, resource ownership and kinship among the Coast Salish does not fit with this model due to the presence of extensive kin networks and a high degree of inter-group interaction (e.g. Suttles 1960; Elmendorf 1971). Instead, shaft barbs may serve as individual or affinal identifiers. Such markers may be a necessity due to the considerable degree of inter-group interaction in the Gulf of Georgia, and the relationship between extensive kin relationships and access to resources (e.g. Suttles 1960).

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